Peer reviewed article

Students' knowledge of symptoms and risk factors of potential life-threatening medical conditions

Adrian Businger[a,b], *Stefan Rinderknecht*[c], *Robert Blank*[d], *Lukas Merki*[e], *Thierry Carrel*[f]

[a] Department of Surgery, St. Claraspital, Basel, Switzerland
[b] Department of Surgery, Division of Visceral Surgery and Transplantation, University Hospital Bern, Bern, Switzerland
[c] Medical Student, Medical Faculty, University of Zurich, Switzerland
[d] Cardiologist, Weinfelden, Switzerland
[e] Department of Intensive Care Medicine, St. Claraspital, Basel, Switzerland
[f] Department of Cardiovascular Surgery, University Hospital Bern, Bern, Switzerland

Summary

Aim: In order to assess medical students' knowledge of Basic Life Support (BLS) principles, we defined a minimal knowledge (MK) of three life-threatening medical conditions that should be universally known: cardiac arrest, heart attack and stroke, and compared the results with those of laypersons.

Methods: Before participating in a BLS course, 406 medical students and 101 laypersons completed an MK questionnaire. Additional data were collected on participants' gender, age, education, medical education, personal experience with the condition and successful completion of a BLS course.

Results: The mean proportion of correct answers was 48.1% for medical students and 34.3% for laypersons (P <0.001). No participant achieved a MK level of 100%. Multivariable analysis showed that medical background +14.8% MK (P <0.001), successful completion of a BLS course +4.4% MK (P = 0.004), and personal experience of the condition +3.2% MK (P = 0.013) significantly enhanced the MK percentage. Interaction analysis suggested that there were no exponential effects of higher education and medical background, or medical background and a completed BLS course.

Conclusion: Among medical students and laypersons there is a significant lack of knowledge regarding the typical signs and risk factors associated with serious medical conditions. Within the current study, participants with direct experience of these conditions exhibited marginally improved knowledge compared to others, indicating a wide gap in the general public's knowledge. There is an urgent need to establish learning objectives in order to encourage students to complete BLS courses during their education.

Key words: medical students; medical knowledge; heart attack; stroke; cardiac arrest; Basic Life Support (BLS)

Introduction

Even though the number of deaths due to sudden cardiac arrest is declining and amounts to 0.4–1/1000 person/year [1, 2], every year about 30 000 patients in Switzerland sustain a heart attack, stroke or cardiac arrest. The majority of patients with out-of-hospital cardiac arrest (OHCA) do not receive adequate resuscitation by healthcare professionals within the critical time (i.e. 3 to 5 minutes) after onset of the condition, thus reducing the chance of survival [3]. The chance of successful resuscitation after sudden cardiac arrest decreased by 7–10% with every additional minute [4]. It is widely accepted that a well established chain of survival based on cardiopulmonary resuscitation (CPR) plus early defibrillation with automated external defibrillators by trained non-healthcare professionals offers a survival advantage over CPR-only in OHCA [5, 6]. The chain of survival includes early activation of emergency medical services, early CPR, early defibrillation, and early advanced life support to reduce death and disability from OHCA [7].

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Conflict of interest: None.

Knowledge of basic life support (BLS) as an immediate intervention is an efficient strategy which favourably influences the course of sudden cardiac arrest. A previously reported study on the typical signs and risk factors of relevant clinical conditions such as heart attack and stroke among Swiss adult citizens showed marked lack of knowledge [8]. This lack of knowledge is apparently associated with lack of the requisite awareness of the importance of BLS. This may be one factor contributing to the limited availability of BLS providers. The American Heart Association (AHA) suggests that morbidity and mortality of OHCA could be significantly decreased if 20% of the population were able to perform BLS [9]. Ignorance regarding symptoms of acute circulatory collapse can be costly with respect to morbidity and mortality, while nescience of the relevant risk factors can potentially cause erratic behaviour. Little information has been published on the level of knowledge in emergency medicine among medical students. Logically, medical students as future health care professionals constitute a group of professionals that should be highly knowledgeable in the area of immediate treatment for serious acute conditions. Even with poor initial knowledge, once medical students are taught CPR effectively they are able to transfer these skills to others [10]. Thus, improvements in understanding of BLS principles among medical students may be an appropriate health policy strategy to increase the limited pool of BLS providers.

The objective of the present investigation was to assess knowledge of and familiarity with BLS among medical students and to compare the results with those of medical laypersons in Switzerland. We hypothesised that knowledge of BLS should be associated with higher levels of education and with medical education. We also evaluated other possible determinants of BLS knowledge.

Methods

Study design and subjects

We approached medical students of different education levels attending practical training in emergency medicine (including BLS) in Zurich, Switzerland in autumn 2008 and in spring 2009 and requested them to complete a self-administered anonymous questionnaire survey (group 1). Each student was briefed on the objective of the study, and verbal consent was obtained from the study participants. We distributed the questionnaires before participants entered the course rooms and advised them to complete the questionnaire as individual work at the beginning of practical training. We collected 406 questionnaires before the lecture started. We also approached participants attending an interdisciplinary practical BLS workshop (n = 101), including representatives from the Swiss Army, Civil Defence and the Fire Service in autumn 2008 (group 2).

The questionnaire consisted of free-response items and an empty flow chart concerning the BLS pathway defined by the AHA guidelines 2005 [11]. Additional participant information was extracted from a general form containing questions about gender, age, study year, education level, medical and paramedical education, and questions on personal experience with the medical conditions (cardiac arrest, heart attack and stroke) in simulation training or private surroundings. We also evaluated whether or not participants had completed a BLS course.

As the survey addressed healthy people on a voluntary and anonymous basis with no incentives and no planned intervention, no further ethical considerations were followed.

Instrument

We developed a questionnaire in German, composed of 8 items with 1–5 responses regarding minimal knowledge (MK) of BLS. To define MK in BLS five experts and members of the Swiss Resuscitation Council were asked to indicate the most familiar symptoms and risk factors of three medical conditions (cardiac arrest, heart attack, stroke) that should be known to everyone without the need for expert knowledge. Based on the experts' statements, we generated 3 questions each for the conditions of cardiac arrest and heart attack and 2 questions related to stroke. The total number of correct answers was 25. We postulated that experts know much more about these conditions than the maximum of the defined minimal knowledge. The questionnaire was pre-tested among ten medical students for readability and acceptability; these questionnaires were excluded from further analysis. The respondents' handwritten answers were assessed in duplicate according to the anticipated answers, and ambiguity was resolved by discussion. Non-distinctive statements were assigned as correct.

Statistical analysis

The MK level was calculated as a percentage, i.e. cumulative total number of correct answers divided by 25 (maximum of possible correct answers), multiplied by 100, with 95% confidence intervals [95% CI] and the minimal knowledge percentage score for each condition was noted. On the basis of the multiple linear regression model we assessed the influence of age, gender, educational level, medical background, personal experience with one of the conditions in simulation training and the social surroundings, with successful completion of a BLS course as independent variables and overall minimal knowledge of BLS (as a percentage) as the dependent variable. All predictor variables were entered at the same time into the model, since not only predictors per se but their intercorrelations were used to improve the prediction of the dependent variable. There were no explorative pretests which resulted in specific exclusions or inclusions in the model (since the inclusion of single variables disregards the existence of interdependencies between variables and multiple linear regression uses these interrelations). Moreover, highly explorative multiple procedures such as stepwise forward or stepwise backward variable selection were avoided, since these highly explorative analyses usually risk replicability of study results.

Furthermore, we examined interactions between university entrance diploma and medical background, illness experience in the personal surroundings and university

entrance diploma, simulation training and medical background, illness experience in the personal surroundings and medical background, being a medical student and successful completion of a BLS course, and illness experience in the personal surroundings and successful completion of a BLS course. Levels of statistical significance were defined as P <0.05. All statistical analyses were performed using SPSS 13.0 (SPSS; Chicago, Illinois, USA) and SAS software version 9.1 (SAS Institute Inc., Heidelberg, Germany).

Results

A total of 406/431 (94.2%) medical students (group 1) and 101/105 (96.2%) course attendees for the interdisciplinary workshop (group 2) participated in the study. Out of the 507 participants 304 (60%) were females. The mean age was 22 years (range 18–50 years). Participant characteristics are shown in table 1.

The mean proportion (95% CI) of minimal defined knowledge of BLS was 48.1% (46.6–49.5) for group 1 and 34.3% (31.5–37.0) for group 2, with a range from 0–84% for group 1 and from 4–80% for group 2. Participants of groups 1 and 2 differed significantly in minimal knowledge for all 3 medical conditions (table 2). No individual participant reached 100% of minimal knowledge in BLS.

Table 1
Demographics of 507 participants.

Characteristic	Group 1 N = 406	Group 2 N = 101	p-value
Age (years)	23 (18–49)	28 (18–50)	<0.001
Sex ratio (M:F)	109/294	91/10	<0.001
Study year (medical school)		n.a.	
Year 1	75 (15%)		
Year 2	78 (16%)		
Year 3	130 (26%)		
Year 4	102 (20%)		
Year 5	8 (2%)		
Year 6	5 (1%)		
University entrance diploma or university degree			<0.001
Yes	406 (100%)	29 (28.7%)	
No	0 (0)	72 (71.3%)	
Medical/paramedical education, self reported			<0.001
Yes	406 (100%)	3 (3%)	
No	0 (0)	98 (97%)	
BLS-course successfully passed			0.336
Yes	244 (60.8%)	56 (55.4%)	
No	158 (39.2%)	45 (44.6%)	
Personal experience of medical conditions?			0.912
Yes	263 (66%)	67 (66%)	
No	137 (34%)	34 (34%)	
Which medical condition?			
Cardiac arrest	70 (18%)	19 (19%)	0.791
Heart attack	191 (48%)	49 (49%)	0.908w
Stroke	187 (47%)	48 (48%)	0.906

Group 1: medical students; Group 2: course attendees (representatives from the Swiss Army, Civil Defence and Fire Service); BLS: Basic Life Support.

Table 2
Participants' minimal knowledge in Basic Life Support.

	Group 1 n = 406	Group 2 n = 101	p-value
MK overall, %	48.1% (0–84)	34.3% (4–80)	<0.001
MK cardiac arrest, %	47.9% (0–100)	41.0% (0–100)	0.001
MK heart attack, %	55.2% (0–100)	38.9% (11–67)	<0.001
MK stroke, %	39.2% (0–86)	19.2% (0–86)	<0.001

MK: minimal knowledge

Table 3

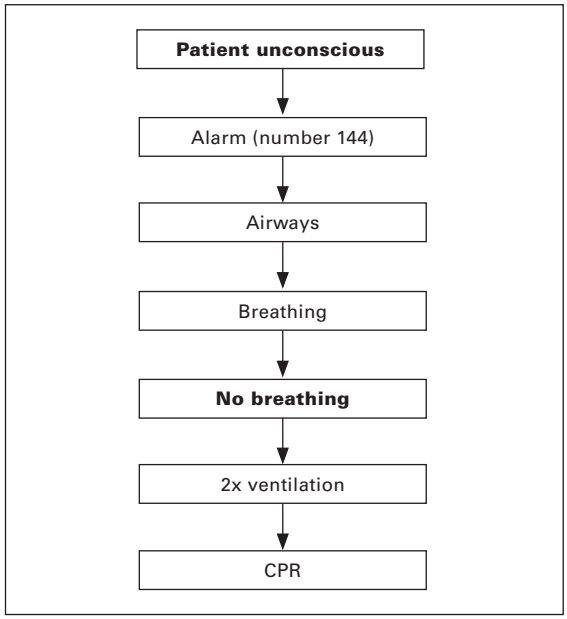
Questions (Q) and corresponding correct answers.

Q1: What can be symptoms of a heart attack? Anticipated answer: Chest pain, radiating pain, unconsciousness.
Q2: What can be symptoms of a stroke? Anticipated answer: Palsy, speech disorder.
Q3: Do you know the symptoms of a cardiac arrest? Anticipated answer: Unconsciousness, apnoea, absent pulse.
Q4: Is there a difference between heart attack and cardiac arrest? Anticipated answer: Yes.
Q5: Is there a difference between unconsciousness and cardiac arrest? Anticipated answer: Yes.
Q6: Please complete the BLS flow chart for laypersons (fig. 1). Anticipated answer: Patient unconscious, Alarm (number 144), Airways, Breathing, No breathing, 2x ventilation, CPR.
Q7: What do you think: What diseases and risk factors mainly increase the risk of having a heart attack? Anticipated answer: Smoking, abnormal blood fat, diabetes, high blood pressure, genetic factors.
Q8: What do you think: What diseases and habits increase the risk of having a stroke? Anticipated answer: Smoking, high blood pressure, abnormal blood fat, diabetes, cardiac arrhythmia.

BLS: Basic Life Support; CPR: Cardiopulmonary resuscitation. Each correct answer is rated as 1 point (maximum 25 points).

Figure 1

BLS flow chart for laypersons according to AHA guidelines 2005 to complete (Question 6).



Terms in bold: written inputs. BLS: Basic Life Support; 144: emergency telephone code; CPR: cardiopulmonary resuscitation. Answers were assigned as correct only when written in a logical manner in the correct field (maximum of 5 points).

Group 1 provided significantly more correct answers than group 2 for symptoms and risk factors of heart attack and stroke, as well as for symptoms of cardiac arrest, and more often scored maximum points for all conditions (table 3). For the question, "Is there a difference between heart attack and cardiac arrest?" 391/406 (96%) of group 1 and 90/101 (89%) of group 2 gave the correct answer (p = 0.003). For the question, "Is there a difference between unconsciousness and cardiac arrest?", the rate of correct answers from group 1 (96% correct) and group 2 (91% correct) did not significantly differ (p = 0.073).

In a scenario with an unconscious person (fig. 1), 22% of medical students and 25% of others (p = 0.579) indicated the alarm correctly; in the same scenario, when the patient has apnoea, 47% of students and 50% of others (P = 0.595) would start with artificial ventilation of the patient. The full scenario was reproduced correctly by 7% (29/406) of medical students and 7% (7/101) of others.

In the overall sample participants with a medical background or with experience of the condition in simulation training or in their personal endeavours, or participants with successful completion of a BLS course, had a higher MK than those without. Age had only a minimal effect on results, while gender had no effect on MK percentage (table 4). Although similar results were obtained in group 1, in group 2 only participants with a medical background showed higher MK than those without. For minimal knowledge results within different subgroups, see table 6.

We subsequently investigated interactions between university entrance diploma/degree and medical background (p = 0.77), familiarity with the condition in their personal experience and university degree (p = 0.07), experience in simulation training for the condition and medical background (p = 0.52), familiarity with the condition in their own personal experience and medical background (p = 0.13), being a medical student and successful completion of a BLS course (p = 0.65), and familiar with the condition in their personal experience and successful completion of a BLS course (p = 0.75), showed no effect on minimal knowledge of BLS and seems not to have an exponential effect. For example, a medical student with simulation training and personal experience in this matter, having successfully completed a course in BLS, has a mean minimal knowledge of BLS of 54%. At the same time, the average minimal knowledge of a participant with no medical background, but who had been exposed to simulation training and experience of the condition and had successfully passed a BLS course, was 49%.

In addition, we investigated whether minimal knowledge would vary according to whether participants had personal experience of a given medical condition or not. For questions regarding cardiac arrest, participants with both personal experience and simulation training related to this condition (n = 40) had a greater minimal knowledge (+12% [11 to 23], p <0.001). For questions regarding stroke, participants with both personal experience and simulation training related to this

Table 4

Influence of different factors on minimal knowledge increase.

Subgroup	N (%)	Regression coefficient β	T-Value	p-Value	95% CI for β	
					Lower board	Upper board
Medical background	409 (80.7)	14.8	3.72	<0.001	8.6	20.9
Simulation training related to the condition	193 (38.1)	4.9	3.06	0.002	1.7	8.0
Personal experience with the condition	330 (65.1)	3.2	2.49	0.013	0.7	5.8
Successful completion of BLS course	300 (59.2)	4.4	2.89	0.004	1.4	7.5
Age	507 (100)	0.5	3.54	<0.001	0.2	0.8

BLS: Basic Life Support

Table 5

Differences in participants' answers.

Questions (Q)		Group 1 N = 406	Group 2 N = 101	p-value
Q1		2 (1–3)	1 (1–3)	<0.01
Q2		1 (0–2)	0 (0–2)	<0.01
Q3		2 (0–3)	1 (0–3)	<0.01
Q4				0.003
	Incorrect (no)	15 (4%)	11 (11%)	
	Correct (yes)	391 (96%)	90 (89%)	
Q5				0.073
	Incorrect (no)	18 (4%)	9 (9%)	
	Correct (yes)	388 (96%)	92 (91%)	
Q6		1 (0–5)	1 (0–5)	0.45
Q7		3 (0–5)	1 (0–4)	<0.01
Q8		2 (0–4)	1 (0–4)	<0.01

Group 1: medical students; Group 2: course attendees (representatives from the Swiss Army, Civil Defence, Fire Service).

Table 6

Minimal knowledge in Basic Life Support by different subgroups.

Subgroup	N (%)	Mean MK (SD)
University entrance diploma or university degree	435 (85.8)	47 (15)
Medical background	409 (80.7)	48 (15)
Simulation training related to the condition	193 (38.1)	52 (14)
Personal experience of the condition	330 (65.1)	47 (15)
Successful completion of BLS course	300 (59.2)	49 (15)
Overall sample	507 (100)	45 (16)

BLS: Basic Life Support; CPR: Cardiopulmonary resuscitation.

condition (n = 24) had a greater minimal knowledge (+15% [14 to 28], p <0.001) than participants without such experience. For questions regarding heart attack, no significant difference in minimal knowledge was detected between participants with and without such personal experience (P = 0.082).

Discussion

Our study shows that medical students as well as laypersons were only moderately aware of BLS principles. While medical background was positively correlated with this knowledge, other factors (personal experience, successful completion of a BLS course) had only a slight or even no effect (gender) on this aptitude.

The rather mediocre average minimal knowledge levels of BLS in medical students and in laypersons (48.1% and 34.3% respectively) indicate a deficiency of awareness and education in both groups. For example, only 25% of the students and laypersons would call an ambulance when someone collapses in front of them. Other authors have found similar lack of ability in medical students to perform resuscitation according to the AHA guidelines [12–14]. In a Japanese study the authors reported that 84% of students were unable to perform resuscitation according to the guidelines [15]. One study found that there is a wide disparity between students' estimation of their own knowledge and skills in BLS and their actual knowledge [12]. The low scores reported by students may be due to several causes. Students may not have spent enough time on theory and practice in BLS during their courses, and older students do not adequately repeat or revisit their BLS training during their curriculum, as postulated by others [12]. Moreover, older students may have more advanced knowledge in resuscitation than in basic resuscitation [16]. Nevertheless, medical students who have successfully completed a BLS course in which the very basics of resuscitation were taught do not exhibit a significantly higher minimal knowledge percentage score in BLS than medical students who have not completed such a course.

This gap in the medical students' knowledge base is obvious and encompasses symptoms, risk factors and emergency treatment of all three medical conditions. Even experience with the medical conditions in a personal setting or in simulation

training did not largely enhance the minimal knowledge percentage in this group. Experience or exposure may not inevitably increase performance [17]. Specific skills were not evaluated in this study, although it should be noted that retention of skills related to cardiopulmonary resuscitation is poor [15, 18]. Others have previously described insufficient knowledge along with insufficient skills in BLS in medical students [18].

When comparing medical students and laypersons, medical students exhibited somewhat higher scores than the others, as is to be expected due to their daily confrontation with health and disease during their studies. Laypersons in our study exhibited only one-third of defined minimal knowledge in BLS; this corresponds to the results of a study in Swiss citizens regarding typical signs and risk factors of relevant clinical conditions (myocardial infarction, stroke, chronic obstructive pulmonary disease, and HIV/AIDS) [8]. We found little improvement in groups with higher education or personal experience of the condition. It seems that general literacy and health literacy are not necessarily related to each other [19].

This study is of great value in that it took in a fairly large sample of students across different years of medical school as well as a sample of medical laypersons. Nevertheless, we are aware that our results must be interpreted with caution. Firstly, our approach included students from one medical school only (University of Zurich, Switzerland) and so does not allow the results to be generalised to students from other medical schools. Secondly, although the participation rate was excellent and representative, we still encountered non-respondents. We cannot exclude the possibility that these persons did not complete the questionnaire because of their low levels of medical knowledge. Thirdly, the participants in both training courses were students and laypersons who were participating on a voluntary basis; hence they were relatively motivated to perform BLS in comparison to other students or members of the general public. This potential bias may lead to overestimation of knowledge. Finally, questions 4 and 5 in the questionnaire may serve as a hint for those who have never evaluated unconsciousness as a symptom of cardiac arrest and who have never thought about differences between heart attack and cardiac arrest, thereby also causing overestimation of knowledge. It must also be borne in mind that filling in a flowchart in an examination appears much easier than providing correct answers in free text; conversely, proceeding according to a defined algorithm in a real emergency is much more difficult than filling in a form.

Conclusion

In conclusion, there is a significant lack of knowledge among medical students regarding the typical signs and risk factors associated with serious medical conditions, although these students still perform favourably in comparison with other population subsets. Participants with personal experience or simulation training related to these conditions have only marginally greater knowledge than others, indicating the wide gap in the general public's knowledge. Thus there is a need for learning objectives to encourage medical students to perform basic life support, to ensure that our doctors have sufficient basic knowledge in resuscitation. Students should regularly refresh their BLS skills and knowledge in hands-on teaching with dummies during their coursework.

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Correspondence:
Adrian Businger, M.D.
Department of Surgery
Division of Visceral Surgery and Transplantation
University Hospital Bern
CH-3010 Bern
Switzerland
E-Mail: adrian.businger@gmx.ch

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